

International Approaches to Implementing *openEHR* systems

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openEHR Foundation – <http://www.openEHR.org>

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Contents

- The Vision of the EHR?
- How we understand the problem
- Large scale EHR strategy
- *openEHR* overview
- Archetypes

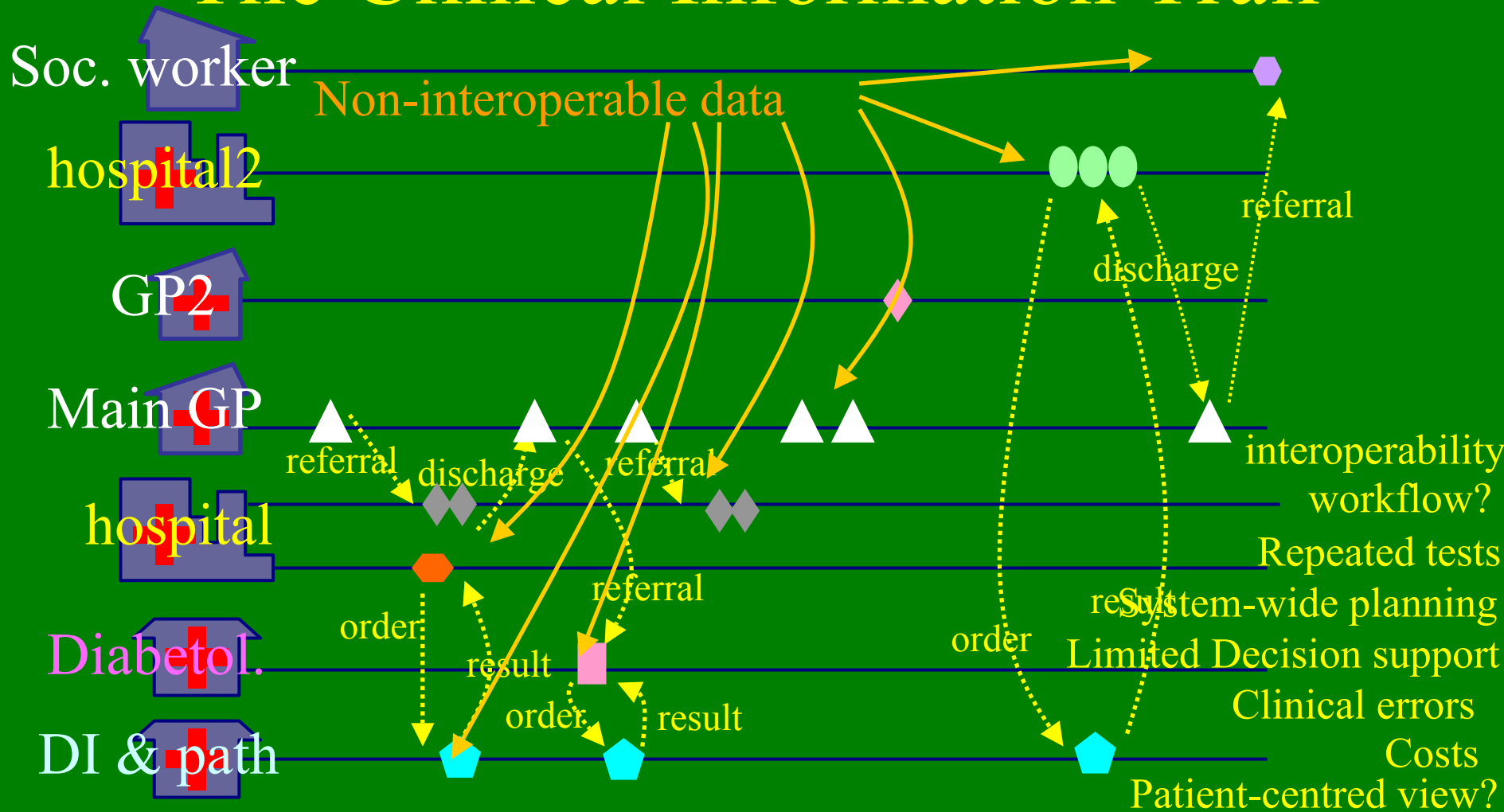
Vision of the EHR

- **Shared care** & education in the community, including with e-communication
- Sharing of health information at **distance** for mobile people and mobile/distance carers
- A **multi-vendor market using open standards**, competing on quality
- Health **information independent of technology**
- Health information to improve **equitable use of finite resources**, reduce wastage
- Better outcomes = a better society

Part I

The Problem

The Clinical Information Trail



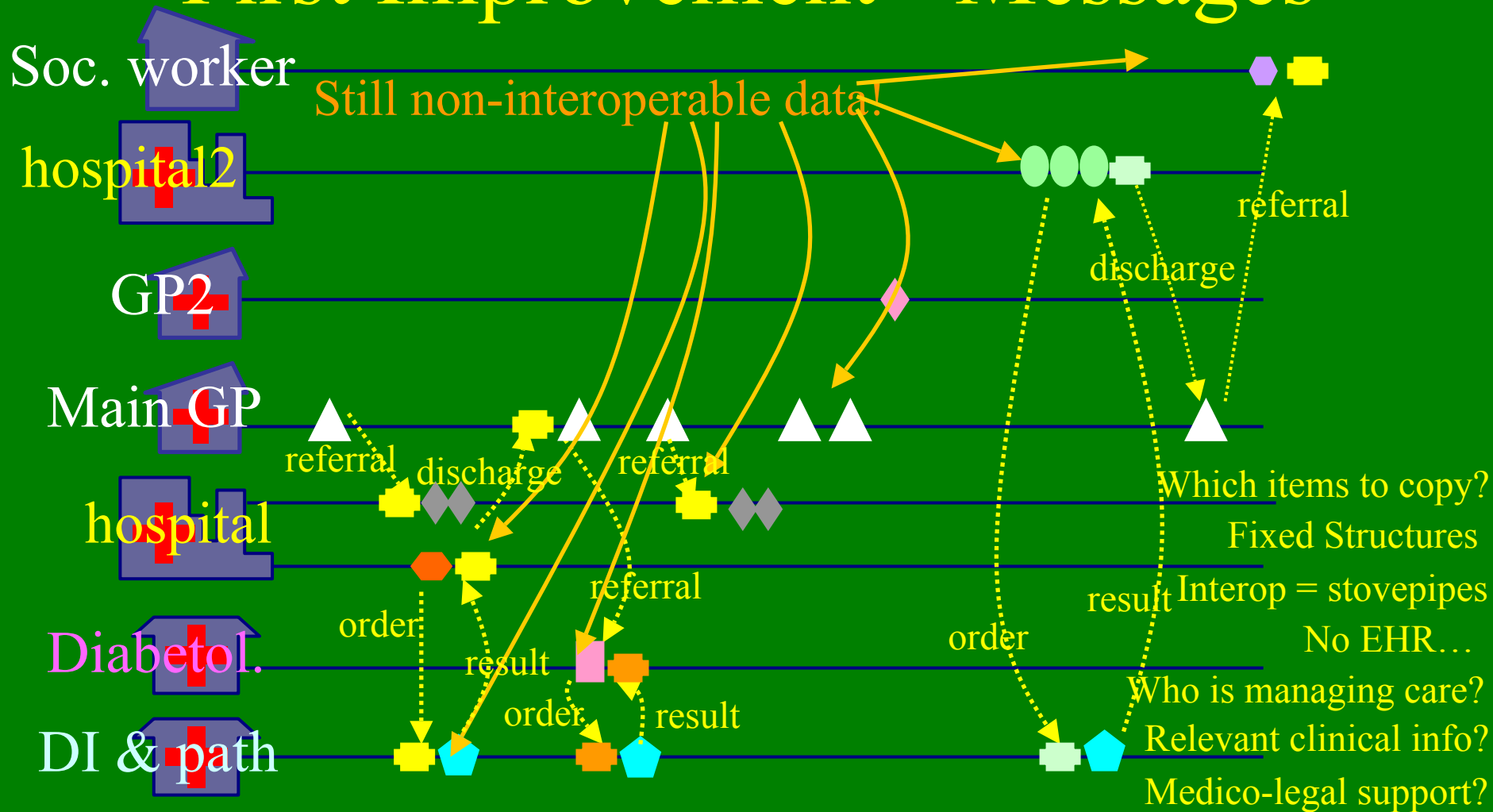
Foot ulcer ⇒ foot clinic (hospital) Chest infection Imaging GP review
 See specialist Renal function test GP visit Back to foot clinic
 See other GP on holiday Stroke – hospital CT scan rehabilitation

Formula I Health

(courtesy Philippe Ameline)

- If the patient is a racing car driver, she makes pit-stops at each health care facility
- Each pit-stop has a video camera, recording what is done to her
- \Rightarrow local pit-stop records, all different, all disconnected
- \Rightarrow no one has a picture of the whole race (= patient's life!)

First Improvement - Messages



Foot ulcer ⇒ foot clinic (hospital) Chest infection Imaging GP review
 See specialist Renal function test GP visit Back to foot clinic
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Issues to Consider

- Limits of messaging for clinical information
 - Ok for predetermined data sets/structures
 - Cost of each additional “stovepipe”
- Main need is for clinicians to be able to see *relevant information when they need it*
- Relevance is to do with:
 - The patient
 - The current problem
 - The current episode

Introducing the EHR

Standardised
Shared EHR

Shared Care, Longitudinal, patient-centred

Soc. worker

hospital2

GP2

Main GP

hospital

Diabetol.

DI & path

EHR VISIBILITY

referral

discharge

Copying controllable

Flexible Structures

Interop = std bus

Patient-centred view

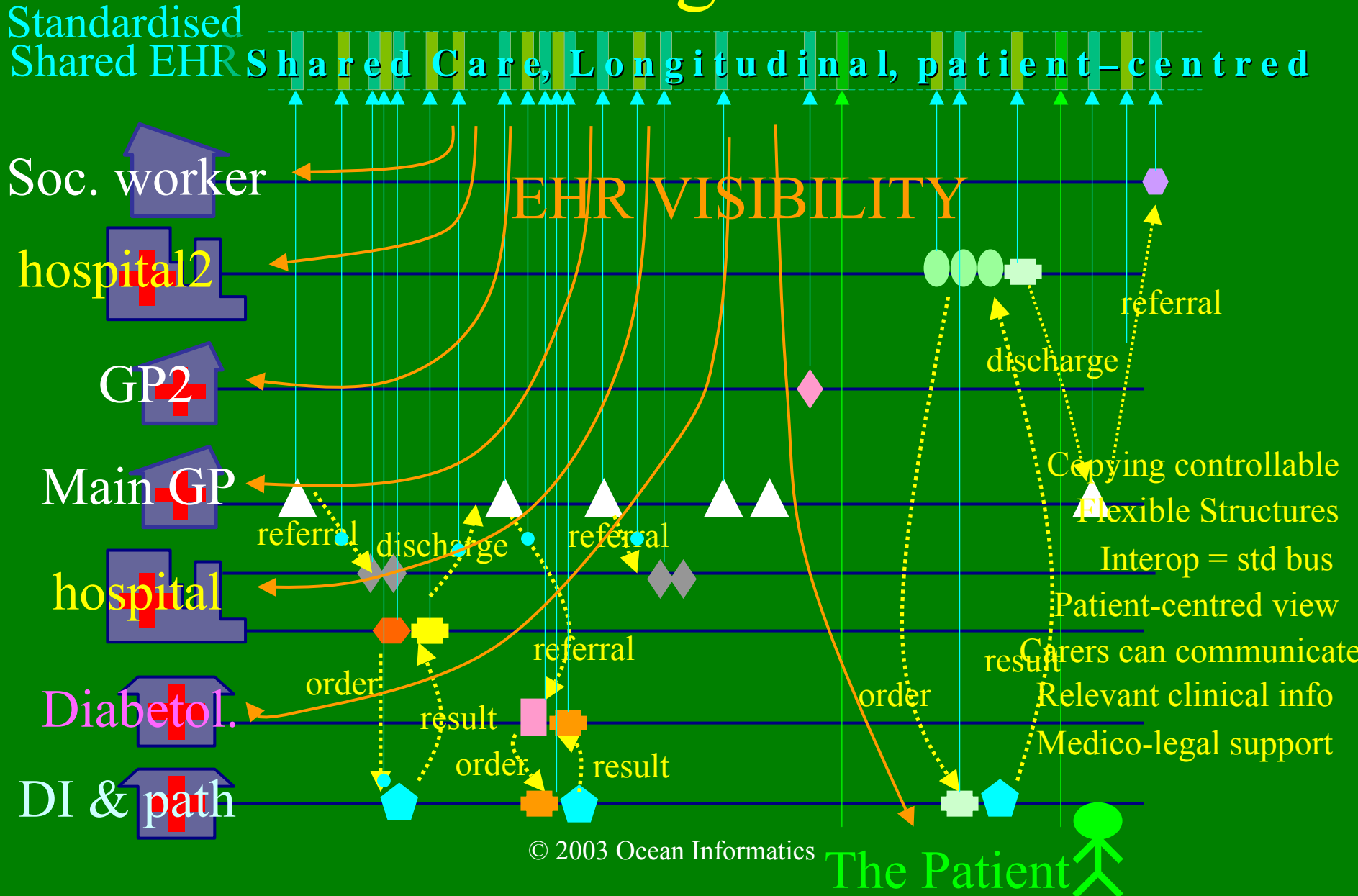
Carers can communicate

Relevant clinical info

Medico-legal support

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The Patient



Formula I Health

(courtesy Philippe Ameline, fr)

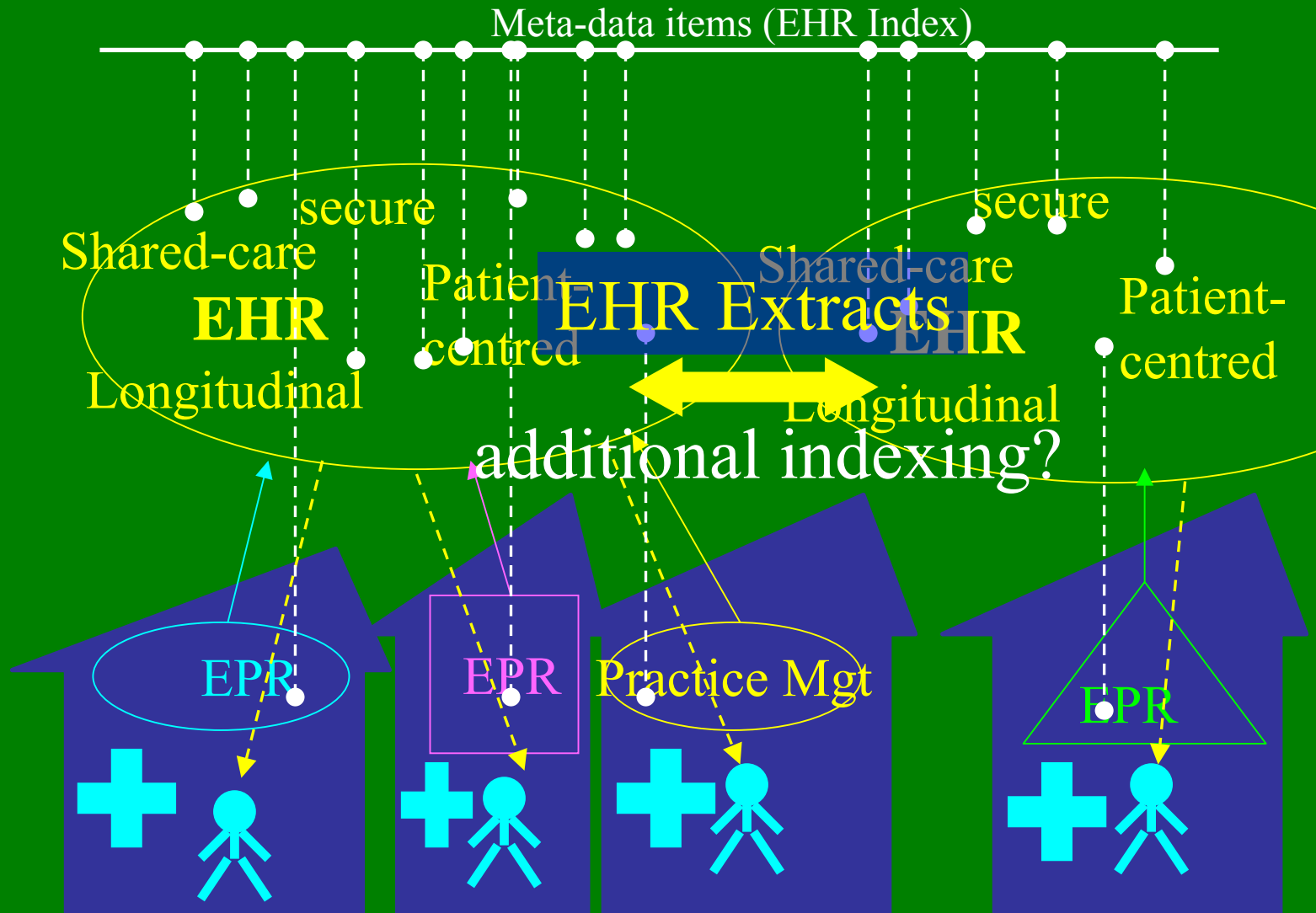
- Our patient now has a video camera in her racing car, taking pictures no matter where the car goes, *and* broadcasting news bulletins to pit-stop crews
- The stream from this camera is the longitudinal, patient-centred EHR...
- The pit-stops may still have their own cameras (EPRs) – local detail
- The patient can add things to own stream
- Continuity of care - patient can have a navigator/co-driver –local GP (care team)

Large-scale EHR strategy

Wide-area
access

Regional,
Patient-centred

Care
Delivery



Strategic Issues

- Technical
 - Consolidated versus “pure federated” EHR
 - Where are EHRs, what governance?
 - Plan for direct modifiers + EPR-> EHR feeder system filtering
 - Centralised *and* distributed systems possible
 - *National* Strategy must use *standards*
- Socio-political
 - Doctors’ Fear of making their information so available
 - Privacy fears of patients
 - Fear of doctors losing control (?!) over patient care
 - Differing national legislation & info-sharing
 - Clinician fear of more data entry

Part II

The *open*EHR approach to Health
Records

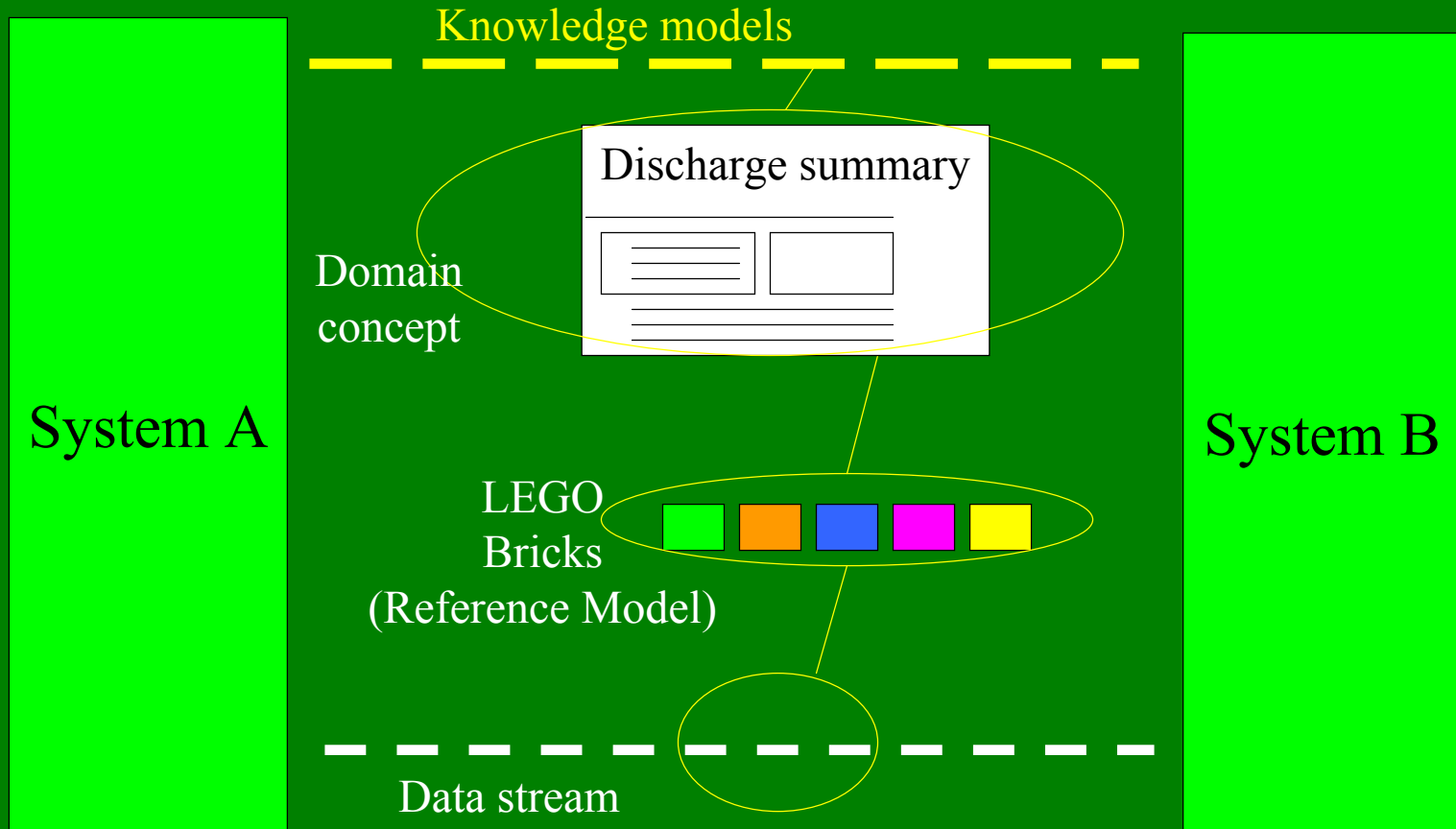
*open*EHR Vision

- Open specifications and implementations
- Cheap, ubiquitous software
- Self-adapting systems
- Clinicians in the driving seat
- Completely knowledge-enabled
- Patient-centred
- Integrated with tele-consultation
- Making standards work!!!

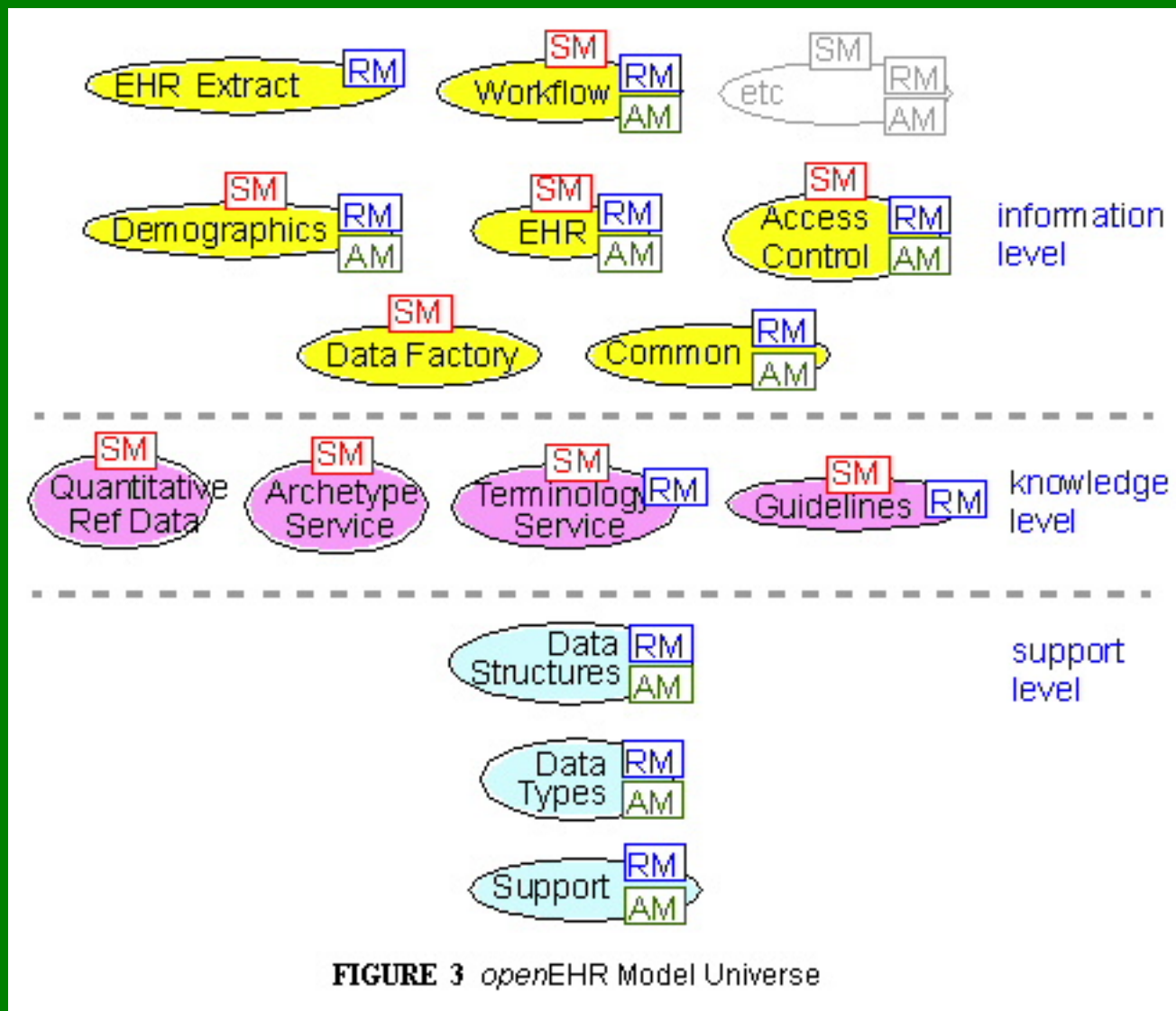
The Main Issue - Interoperability

- Needs to exist at data and knowledge levels
- Systems need to be economic to implement
- Systems need to be self-adapting

Knowledge-level interoperability



openEHR Specification Space



Logical building blocks of the EHR

Framework

EHR

The electronic health record for one person

Folders

High-level organisation of the EHR
e.g. per episode, per clinical speciality

Compositions

Set of entries committed at one date/time
e.g. progress note, report, letter, test result

Sections

Clinical headings reflecting the workflow and consultation/reasoning process

Entries

Clinical “statements” about Observations, Evaluations, and Instructions

Clusters

Compound entries
e.g. blood pressure, full blood count

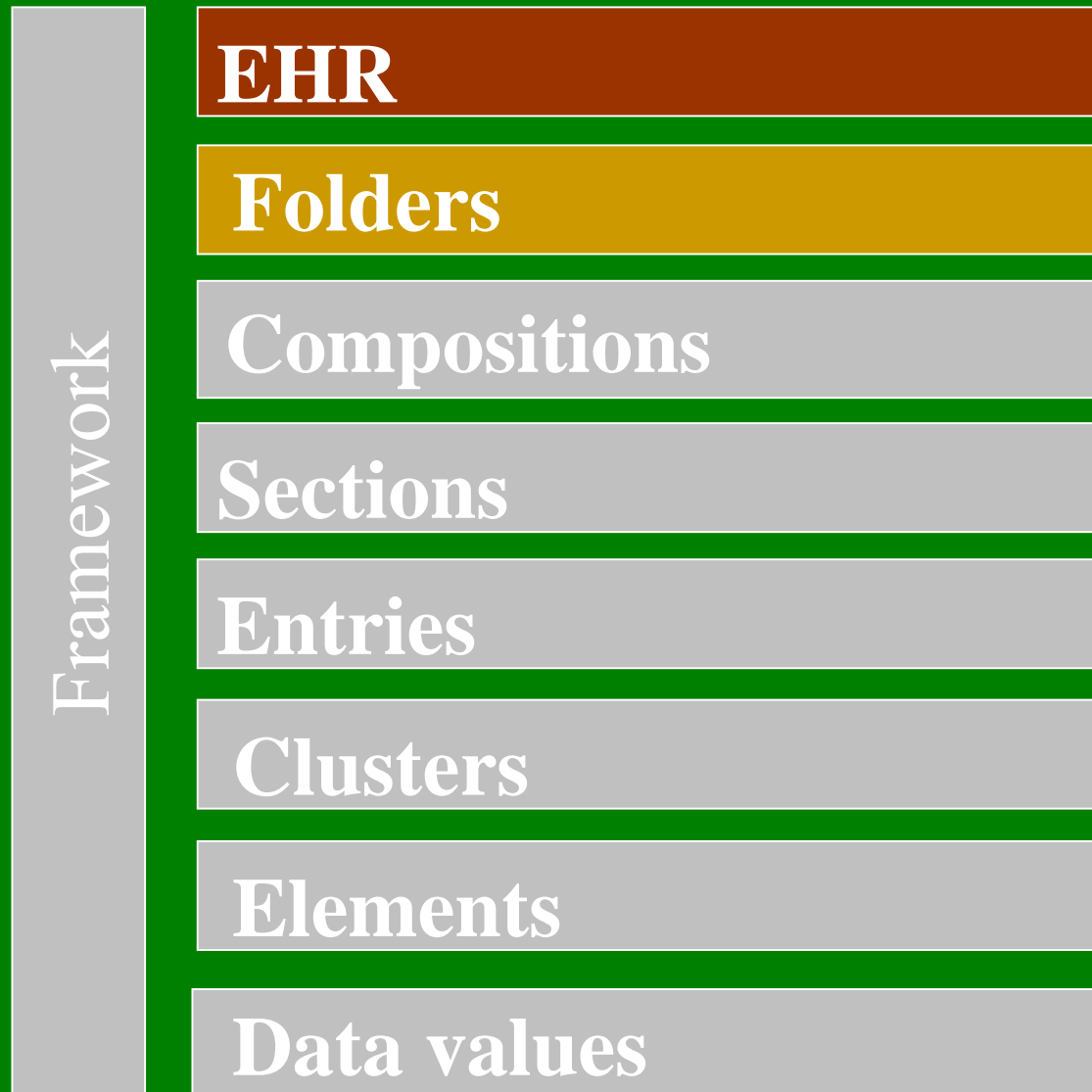
Elements

Element entries
e.g. reason for encounter, body weight

Data values

e.g. Coded terms from term sets, measurements with units

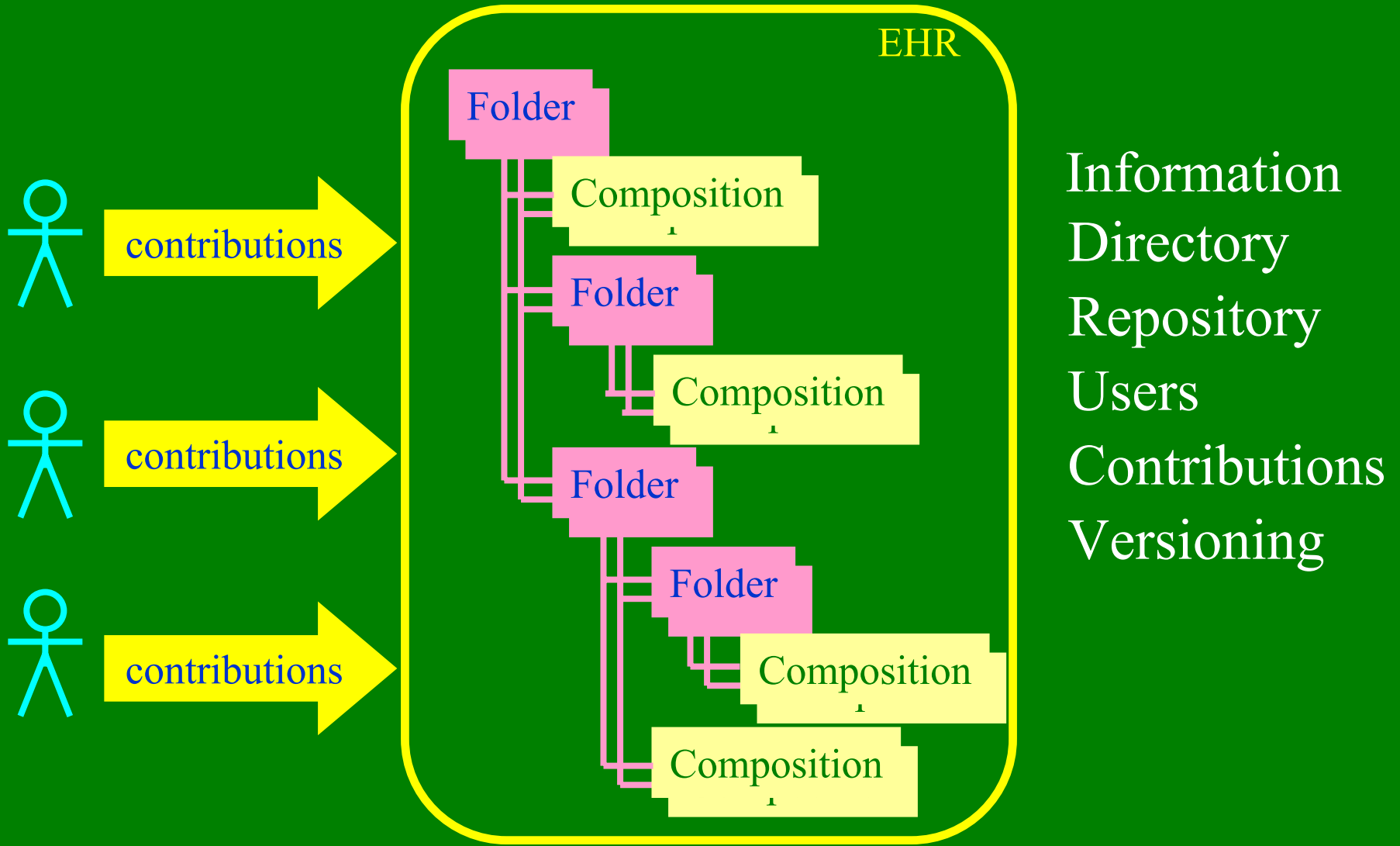
EHRs & FOLDERs



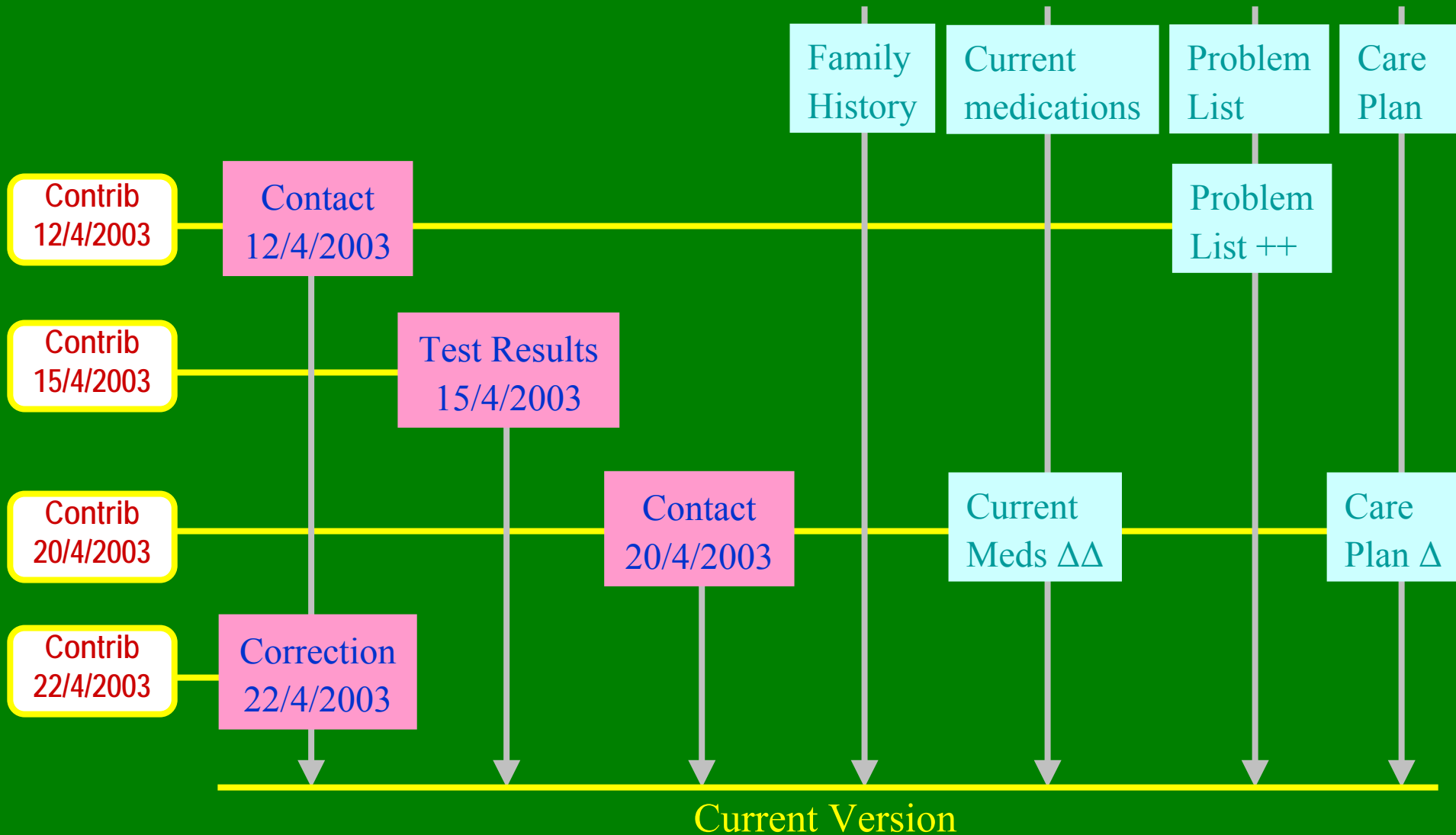
Key Features

- Versioned EHR
 - Essential for medico-legally safe EHR
 - Essential for clinical integrity of information
 - Needed whenever there are multiple simultaneous information modifiers
- Entry
 - Data/state/protocol/reasoning (4 w's)
 - Act/participation/role

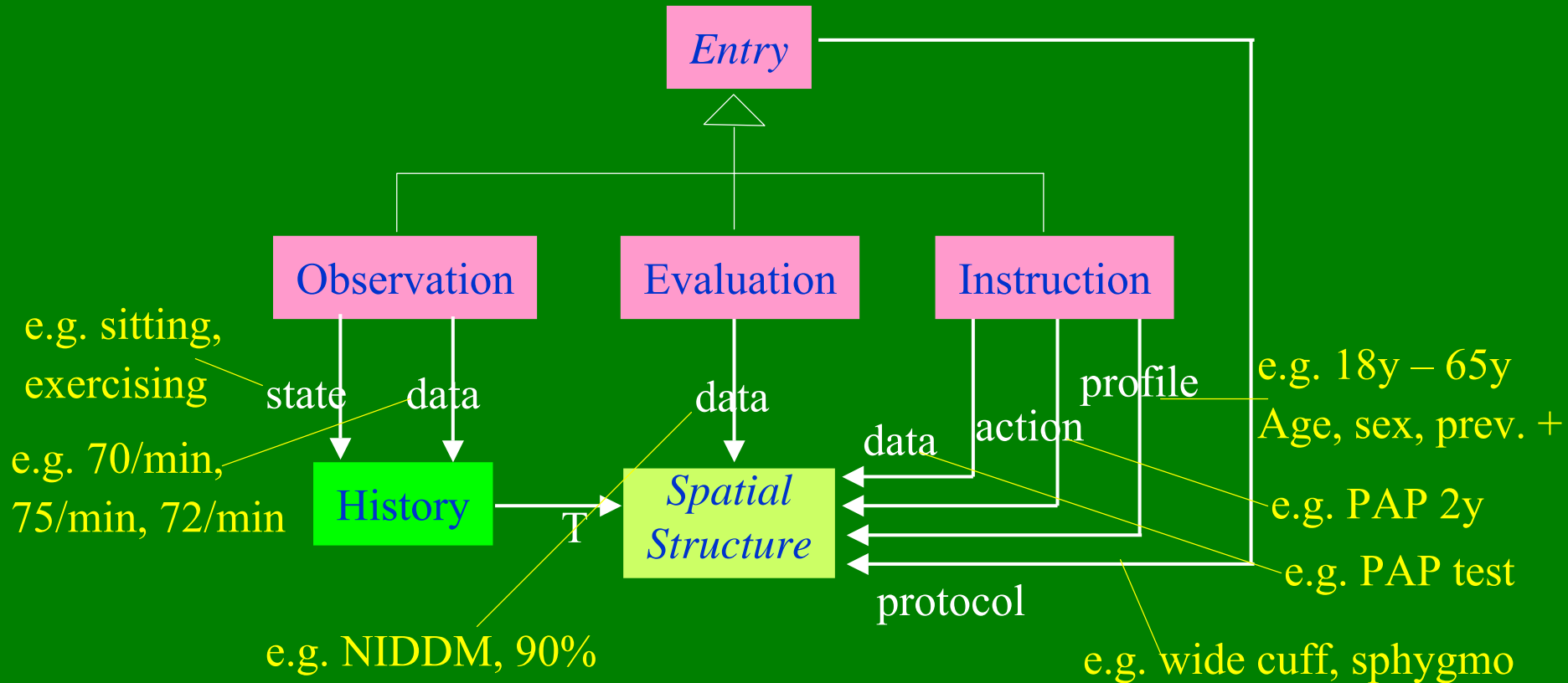
EHR Configuration Management



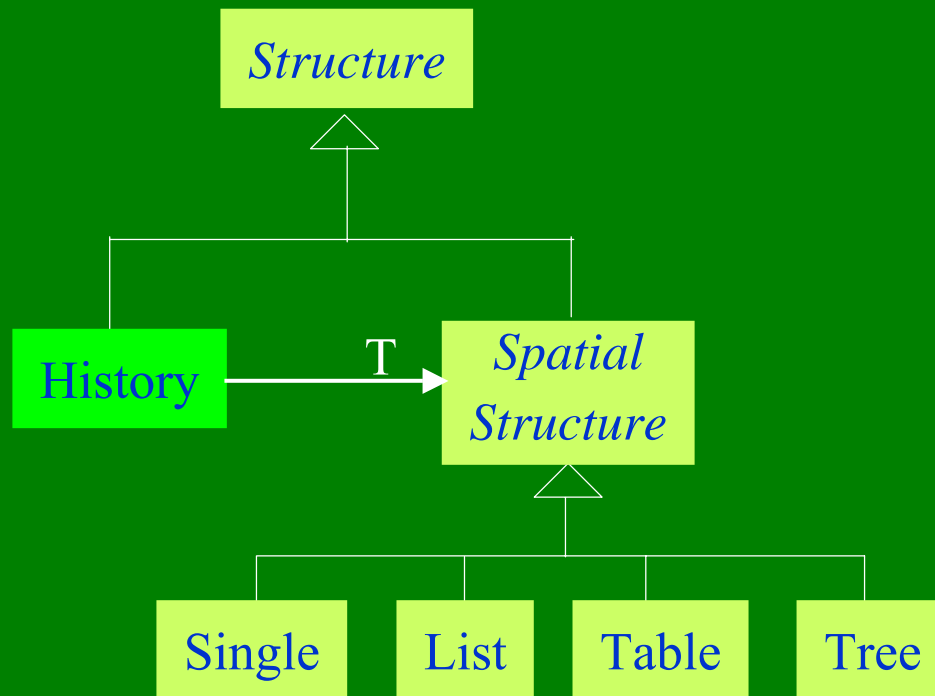
How Contributions Work



Entry



Structures



Part III

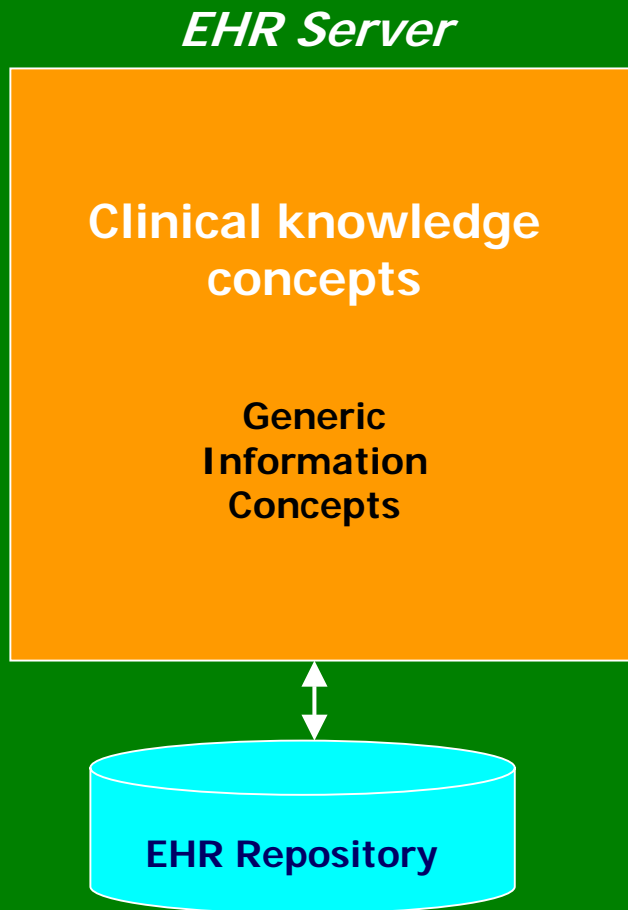
Archetypes

What is an Archetype?

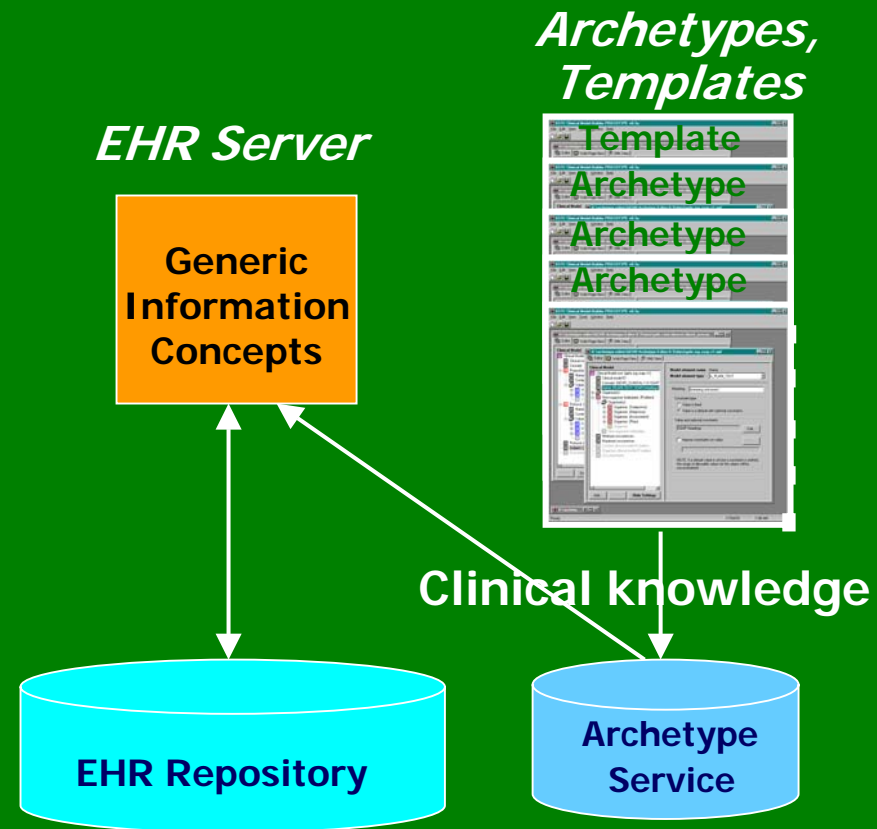
- A formal model of a domain concept, e.g. “blood pressure”, “discharge summary”, “vaccination history”
- Used at runtime:
 - To validate data creation (GUI, legacy db)
 - To do intelligent querying
 - To enable knowledge-level interoperability
- Basis of standardisation of domain concepts

Basic Approach

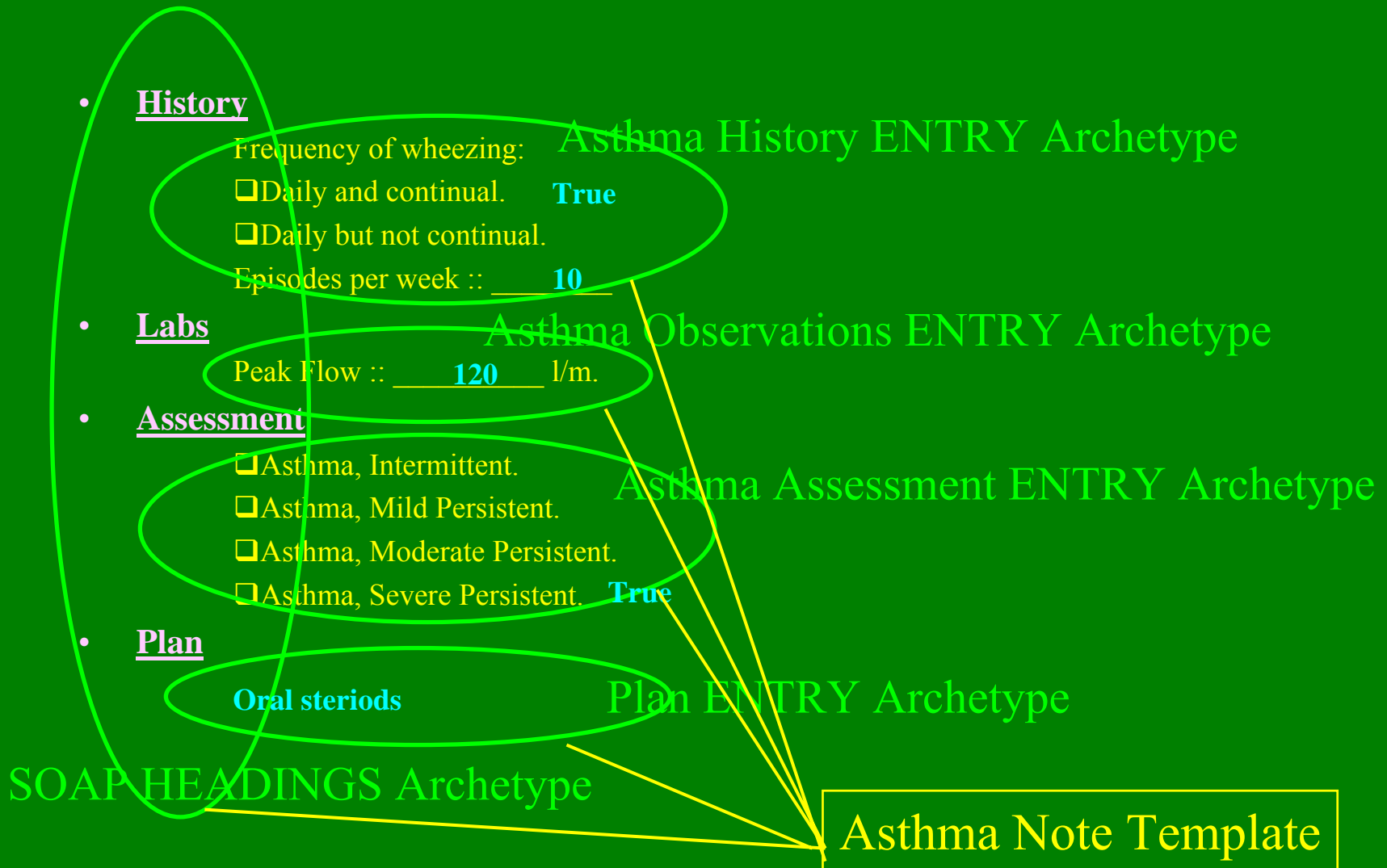
Current clinical systems



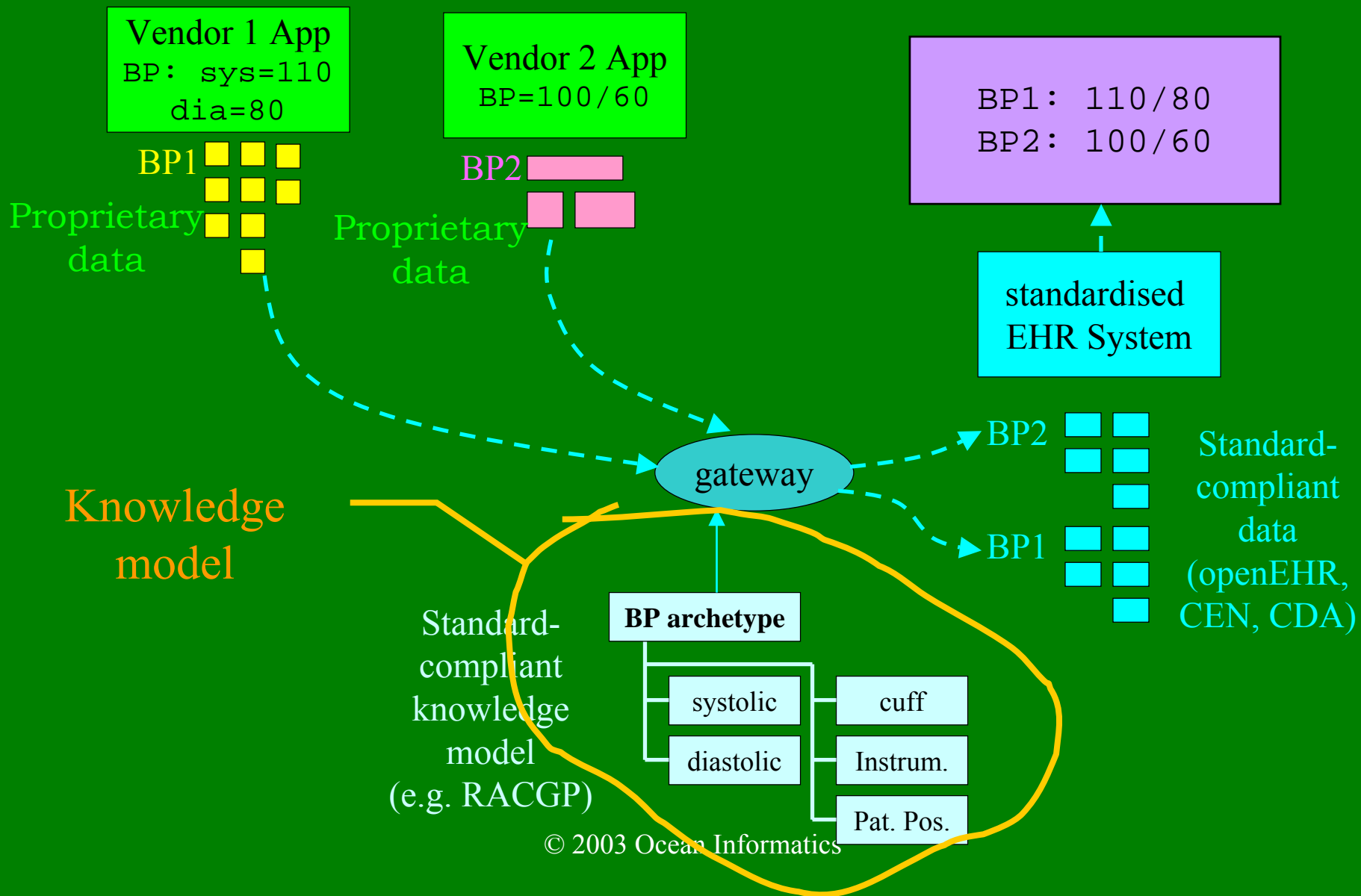
Knowledge-driven clinical system



Archetypes & Templates



Handling Legacy Data



ADL – Archetype Definition Language

- An abstract constraint syntax for clinical models
- Can express archetypes for any information model
- Natural Language and Terminology independent
- Allows clinicians to build definitions of their data, using friendly tools
- Provides a bridge between standards – HL7, CEN, EDI, XML....
- Openly available from <http://www.openEHR.org>

Open

Parse

Edit

Save

Format

native

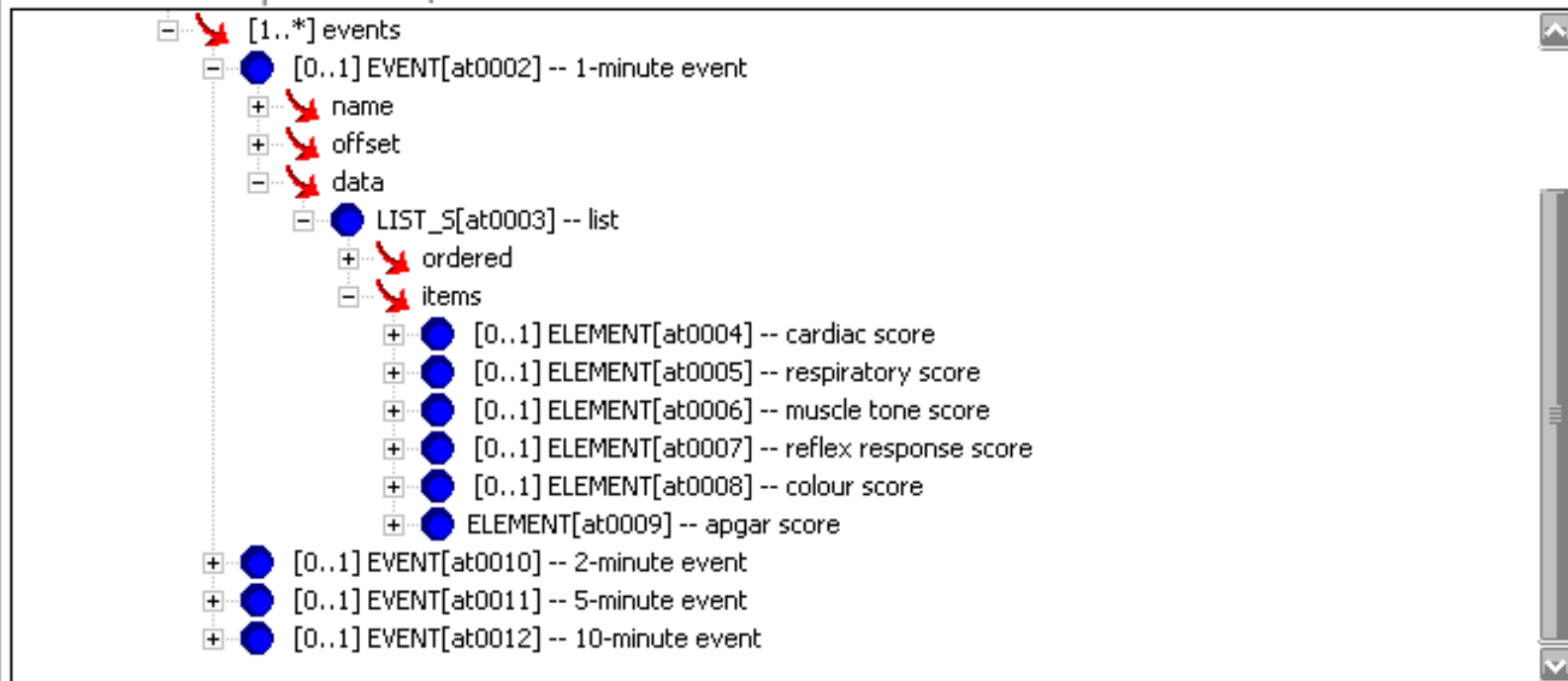
openehr-ehr-entry.apgar_result.draft

Language

Source

Node Map

Found Paths



Archetype openehr-ehr-entry.apgar_result.draft syntax VALIDATED
 Archetype openehr-ehr-entry.apgar_result.draft ontology validation PASSED

Term Defs

Constraint Defs

Term Bindings

Constraint Bindings

code	text	description
at0000	apgar result	apgar result of newborn
at0001	history	history
at0002	1-minute event	record of score at 1 minute
at0003	list	list

Part IV

Systems & Experience

Experience with Archetypes

- UK – CEN/SynEx archetypes
 - anti-coag. system – Whittington Hospital (java/Oracle)
 - Devon ERDIP demonstrator (java/Oracle)
- US –
 - Initial steps in IHC / 3M system
- Australia
 - 3 GeHR pilot projects – legacy & GP data (various)
 - Operational obstetrics system in NSW (Dos, NT)
- France
 - Odyssée GI endoscopy system (20 hospitals) (C++)
- Denmark
 - Aarhus Regional Health Authority ([SSA/AMT](#))

Lessons so far...

- Build reference models AND archetypes simultaneously - archetype development will change reference models!
- Clinicians want to be involved, and are starting to use the tools
- Archetypes can be used for legacy data purification
- Use abstract syntaxes (e.g. ADL, OWL) - XML should be invisible
- Archetype-enabled kernel is non-trivial
- Overall framework proven

Lessons so far...

- Small modular software possible
- Minimal software maintenance
- All the work is now in archetypes, templates and among clinicians
- Self-building GUIs not far off (DSTC, NL, SSA)

Where is it going?

- CEN TC/251 13606 has incorporated archetypes
- ADL is major input to HL7 templates work
- Australian *openEHR* trial for federal HealthConnect EHR/event summary infrastructure
- Canadian InfoWay investigating *openEHR*
- 2 of the largest IT vendors exploring archetypes
- Many open source developers
- US VHA studying it
- Commercial developments starting

Questions (in the open air...)



The development strategy

- Use a multi-vendor strategy
- Solve integration first
- Make interfaces between modules public
- Use of standard, non-proprietary technology
- Develop EPR with massive input from clinicians

The Electronic Patient Record

The Clinical Workplace – An Overall View

- Flexibility and dynamic
- Interdependence and consistency
 - Journal/Notes
 - Medicine
 - Requisitions/Reply
 - Booking
 - Images
 - ...
- Framework system
 - Ensuring Interdependence and consistency
 - Homogeneous look & feel
 - One overall clinical tool

The screenshot shows the CAVE Electronic Patient Record (EPR) interface for patient Irene Olsen. The window title is "Lægesek. Lisbeth Christensen (LIC), Afd: Industrial Systems, Systematic". The patient's ID is 030864-0000. The interface is divided into several sections:

- Administrativ Patientforløb**: Includes tabs for Booking, Ambulatoriet, Radiologiske us, and Patologiske us.
- Left Panel (Tree View)**: Shows a hierarchical structure of patient data, including Stamoplysninger, Indlæggelse, Undersøgelser, and Ambulatorium.
- Central Panel (UL-skanning)**: Displays patient information such as "Modtagende afdeling" (Gynækologisk afdeling Y6, Skejby sygehus), "Datotid for begivenhed" (12 aug 2000), and "Diagnose ved indlæggelsen" (Graviditas extrauterina obs. pro.).
- Right Panel (Medicine and Lab Results)**: Includes a table for "Aktuel medicin" and "Ny ordination", and a table for "Tabel" showing lab results for Hemoglobin, Natrium, and Creatin.
- Bottom Panel (Images and Graphs)**: Shows an ultrasound image (ku1.jpg) and a line graph for "Natrium" with a legend for various lab tests.

Why the Domain Object Model?

Domain Object Model

Action


Blood Pressure
Measuring

Systolic pressure

Diastolic pressure

Placement of the Cuff

Dynamic User Interface



The screenshot shows a user interface titled "Blodtryksmåling" (Blood Pressure Measurement). It contains three input fields with labels in Danish: "Systolsk blodtryk" (Systolic blood pressure) with a value of 140, "Diastolsk blodtryk" (Diastolic blood pressure) with a value of 95, and "Manchettens placering" (Cuff placement) with a value of "Højre" (Right).

- The model supports changing clinical needs
- The dynamic user interface is managed by a subjacent model
- The automation ensures quick and efficient support of clinical needs - without re-programming